**ASSOCIATION OF ACCOUNTING TECHNICIANS OF SRI LANKA**

## AA1  EXAMINATION - JANUARY 2017

## (AA12) QUANTITATIVE METHODS FOR BUSINESS

- **Instructions to candidates** (Please Read Carefully):

  (1)  **Time allowed:** *Reading   -   15 minutes.*

      *Writing    -   03 hours.*

  (2)  ***All questions should be answered.***

  (3)  ***Answers*** *should be in* **one language**, *in the* **medium** *applied for, in the* **booklets** *provided.*

  (4)  *Submit all workings and calculations. State clearly assumptions made by you, if any.*

  (5)  *Use of Non-programmable calculators is* **only** *permitted.*

  (6)  ***Graph Paper*** *and* ***Mathematical Tables*** *will be provided.*

  (7)  ***Action Verb Check List*** *with definitions is attached. Each question will begin with an* ***action verb*** *excluding OTQ's. Candidates should answer the questions based on the* ***definition*** *of the verb given in the Action Verb Check List.*

  (8)  ***Formulae Sheets*** *are attached.*

  (9)  *100 Marks.*

## SECTION A

### Objective Test Questions (OTQs)

Fifteen (15) compulsory questions

(Total 40 marks)

### Question  01

*Select the most correct answer for question No.* ***1.1*** *to* ***1.10***. *Write the number of the selected answer in your answer booklet with the number assigned to the question.*

**1.1**  The ratio of the number of girls and number of boys sat for an examination was 4 : 5. If there were 8,000 girls sat for that examination, the total number of students sat for the examination was:

(1)  20,000      (2)  18,000      (3)  10,000      (4)  9,000

(03 marks)

**1.2**  Rs.12,000/- is deposited at the end of every year at the interest rate of 8% per annum. The present value of the annuity at the end of 4 years is *(to the nearest rupee)*:

(1)  Rs.51,840/-.      (2)  Rs.12,960/-.      (3)  Rs.39,744/-.      (4)  Rs.48,000/-.

(03 marks)

**1.3** The probability that **Amal** passes the selection test is $\frac{2}{3}$ and the probability of **Kamal** passes the same test is $\frac{2}{5}$ .

The probability that both of them fail the selection test is:

(1) $\frac{4}{15}$　　　　(2) $\frac{1}{5}$　　　　(3) $\frac{1}{2}$　　　　(4) $\frac{4}{5}$

(03 marks)

**1.4** The probability distribution for "Modern Clothing" sales outlets' weekly demand for garments has been computed as follows:

| No. of garments (units) | 2,500 | 3,500 | 4,500 | 5,500 |
|---|---|---|---|---|
| Probability | 0.30 | 0.45 | 0.20 | 0.05 |

Based on the above distribution, the expected weekly demand for garments in units would be:

(1)　3,000　　　　(2)　3,500　　　　(3)　4,000　　　　(4)　4,500

(03 marks)

**1.5** Rs.4,000,000/- is deposited into a bank account at an annual interest rate of 8% per annum. The difference in interest between compounded interest and simple interest at the end of 4 years would be *(to the nearest rupee)*:

(1)　Rs.1,441,956/-.　(2)　Rs.280,000/-.　　(3)　Rs.161,956/-.　(4)　Rs.1,280,000/-.

(03 marks)

**1.6** Four scatter diagrams drawn for different data sets are given below:



Diagram I

Diagram II

Diagram III
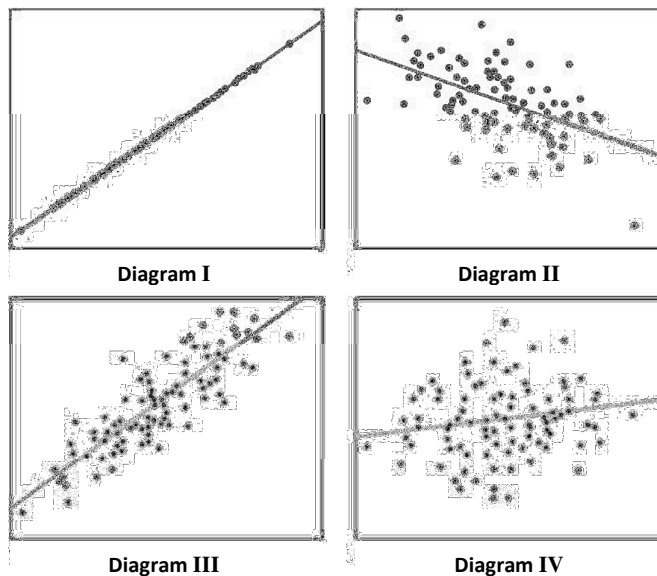
Diagram IV

Consider the following statements:

(a)　*r* of **Diagram I** is + 1.00.　　　　(b)　*r* of **Diagram II** is - 0.50.

(c)　*r* of **Diagram III** is + 0.15.　　　(d)　*r* of **Diagram IV** is + 0.85.

Out of the above, the correct statement/s relating to *r* is/are:

(1)　**(a)** only.　　　　　　　　　　　(2)　**(a)** and **(b)** only.

(3)　**(a), (b)** and **(d)** only.　　　　　(4)　**(b), (c)** and **(d)** only.

(03 marks)

**1.7** The 1$^{st}$ term and the 4$^{th}$ term of an arithmetic progression are 2 and 20 respectively. The common difference of this arithmetic progression is:

(1)   3                        (2)   9                        (3)   6                        (4)   12

(03 marks)

**1.8** The following table shows the cost information and selling price of **product X**, for the month of January:

|                             | Rs.    |
| --------------------------- | ------ |
| Total Fixed Cost per month  | 61,000 |
| Variable Cost per Unit      | 29     |
| Selling Price per Unit      | 69     |

Based on the above information, the break-even sales quantity for the month is:

(1)   700 units.        (2)   884 units.        (3)   1,025 units.        (4)   1,525 units.

(03 marks)

*Use the table below to answer question No. **1.9** and **1.10**.*

*Sales (in units) of **commodity P** for the first 3 quarters of 2016 is given in the below table. Multiplicative model has been used to arrive at seasonal variations.*

|                    | 1$^{st}$ quarter (Q$_1$) | 2$^{nd}$ quarter (Q$_2$) | 3$^{rd}$ quarter (Q$_3$) |
| ------------------ | ------------------------ | ------------------------ | ------------------------ |
| Sales (units)      | 1,800                    | 5,200                    | 2,000                    |
| Seasonal variation | - 25 %                   | + 100 %                  | - 35 %                   |

**1.9** Using the above data, the trend sales for the 1$^{st}$ quarter (Q$_1$) of 2016 in units is:

(1)   1,440                (2)   2,400                (3)   3,600                (4)   7,200

(03 marks)

**1.10** The seasonal variation for the 4$^{th}$ quarter (Q$_4$) of 2016 is:

(1)   - 40%                (2)   0%                (3)   40%                (4)   50%

(03 marks)

*Write answers for question No. **1.11** to **1.15** in your answer booklet with the number assigned to the question.*

**1.11** A manufacturer keeps a profit margin of 25% on cost of a certain item. He has sold 200 units during the last month. The total profit earned during the last month is Rs.240,000/-. Entire production of the month is sold in the same month. Calculate the selling price per unit for the last month. (02 marks)

**1.12** The price of a commodity in year 2012 was Rs.200/- and it is Rs.300/- in year 2016. Find the price relative in year 2016 considering the year 2012 as the base year. (02 marks)

**1.13** State two(02) limitations of index numbers. (02 marks)

*Use the following information to answer question No. **1.14** and **1.15**.*

In an examination, it was observed that 25% of students failed in Economics, 20% of students failed in Accounting and 10% of students failed in both these subjects. If a student is selected randomly, calculate the following:

**1.14** The probability of failing him in Accounting if he failed in Economics. (02 marks)

**1.15** The probability of failing him in Economics if he failed in Accounting. (02 marks)

———— *End of Section A* ————

# SECTION B

Four (04) compulsory questions

(Total 40 marks)

## Question 02

(a)  A company which produces and sells a single product has a weekly fixed cost of Rs.900,000/-. The variable cost function is given by V $(x)$ = 8,000 $x$ + 1,000 $x^2$. The weekly demand function for this product is $D$ $(x)$ = 120,000 – 1000 $x$ , where $x$ is the weekly output.

**You are required to,**

(i)   **Identify** the Total Cost Function and Total Revenue Function.

(ii)  **Calculate** the number of units at which the profit is maximized. (06 marks)

(b)  **Nimal** is considering to borrow Rs.150,000/- to buy a land at 6% interest per annum repayable in 5 equal annual installments at the end of every year.

**You are required to,**

**Compute** the value of the installment to be paid per annum for the loan *(to the nearest rupee)*.
(04 marks)
(Total 10 marks)

## Question 03

(a) The table below shows the price (p) and quantity (q) of sales of 3 items for the years 2014 and 2015 in a Food City Chain in Sri Lanka.

| Item | Price per Unit (Rs.) | | Quantity of Sales (in units) | |
|---|---|---|---|---|
| | 2014 ($p_0$) | 2015 ($p_1$) | 2014 ($q_0$) | 2015 ($q_1$) |
| A | 850 | 1,150 | 1,100 | 980 |
| B | 600 | 610 | 500 | 500 |
| C | 450 | 350 | 1,400 | 1,650 |

**You are required to,**

**Calculate** the Base Weighted Price Index (Laspeyre's Price Index) for the year 2015 considering 2014 as the base year. (04 marks)

(b) Power generation of **XYZ Hydro Power Plant** depends heavily on the monthly rainfall. A set of University students visited the power plant in July 2016 and collected the following information.

- Of the total power generated during the first 6 months, the power generated in January accounted for 20%. During February, the power generation increased by 13,500 units when compared to the January power generation as a result of the heavy rains.

- During March, the Power plant was shut down for annual preventive maintenance for a week. Hence the power generation declined by 15,000 units compared to the February month.

- The total number of units generated in April and May recorded as 135,000 units and 90,000 units respectively.

- The total units generated during the 6 months works out to 750,000 units.

After returning to the University, they have to complete the information in the following format:

| Month | Monthly Power Generation as a percentage of Total power Generation during 6 months (%) |
|---|---|
| January | |
| February | |
| March | |
| April | |
| May | |
| June | |
| **Total** | **100%** |

**You are required to,**

**Calculate** the power generation for each month in degrees using the above data to draw the pie chart. *(You are not required to draw the pie chart)* (06 marks)

(Total 10 marks)

## Question 04

(a)    The below table shows the average height of 100 trees in an estate:

| Average Height (meters) | No. of Trees |
|---|---|
| 1 - 3 | 50 |
| 4 - 6 | 30 |
| 7 - 9 | 20 |

**You are required to,**

**Calculate** the following for the height of 100 trees:

(i)    The mean.

(ii)    The standard deviation.                                                                (04 marks)

(b)    Total Cost Function (TC) and Total Revenue Function (TR) of a manufacturing organization are as follows:

$$TC \ = \ 6x + 560$$

$$TR \ = \ 31x + 510 \ ; \quad \text{where } x \text{ is the number of units produced.}$$

**You are required to:**

(i)    **Draw** the Total Cost Function and Total Revenue Function on a graph paper.
*(Note: Select the number of units ranging from 1 to 5 units)*

(ii)    **Identify** the breakeven number of units using the above graph.          (06 marks)
                                                                            (Total 10 marks)

## Question 05

A company is considering buying a new machinery for its' production process and cash flows pertaining to 2 mutually exclusive machineries ($M_1$ and $M_2$) are given in the below table:

| Year | Cash flow (Rs.'000) | |
|---|---|---|
| | $M_1$ | $M_2$ |
| 0 | (60) | (50) |
| 1 | 20 | 15 |
| 2 | 20 | 15 |
| 3 | 20 | 10 |
| 4 | 20 | 10 |

The lifetime of these two machineries is four years. At the end of four years these machineries could be sold for 10 % of their respective initial purchase price. The expected cash inflows from disposal of machineries at the end of 4th year have not been included in the cash flows of the above table.

Assume that the company's cost of capital is 9 % per annum.

**You are required to:**

(a)    **Calculate** the Net Present Value (NPV) for both machineries separately.

(b)    **Identify** the machinery that should be purchased by the company with reasons.          (10 marks)

––––––––––––––––––––––––––––––– *End of Section B* –––––––––––––––––––––––––––––––

# SECTION C

One (01) compulsory question

(Total 20 marks)

## Question 06

(A) (a) **Draw** a normal distribution curve to demonstrate the area under mean ± standard deviation ($\mu \pm \sigma$) to indicate the area covered under the specified area. (02 marks)

(b) A company has conducted an exam to recruit Management Assistants. According to the exam results, the average pass mark (mean) is 76 with a standard deviation of 15. It follows a normal distribution and 15% of the candidates have got distinctions.

**You are required to:**

**Identify** the minimum marks required for a distinction. *(to the nearest integer)* (05 marks)

(B) In year 2016, 5 graduates applied for the post of "Management Trainee" in a leading company and they had to sit for an aptitude test as well as to an oral interview.

$x$ - Scores obtained from the aptitude test

$y$ - Scores obtained at the interview

Regression table for the above information has been given below:

| $x_i$ | $y_i$ | $xy$ | $x^2$ |
|---|---|---|---|
| 65 | 75 | 4,875 | 4,225 |
| 80 | 78 | 6,240 | 6,400 |
| 72 | 65 | 4,680 | 5,184 |
| 95 | 75 | 7,125 | 9,025 |
| 55 | 68 | 3,740 | 3,025 |
| $\sum x$ = 367 | $\sum y$ = 361 | $\sum xy$ = 26,660 | $\sum x^2$ = 27,859 |

**You are required to:**

**Identify** the Regression Line given by $y = a + bx$ using the above information. (06 marks)

(C) The following table shows the age of a machinery and the related maintenance cost for the 13 years:

| Age ($x$) | 2 | 4 | 6 | 8 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|
| Cost ($y$) *(in Rs. '000)* | 5 | 10 | 12 | 14 | 18 | 21 | 26 | 32 |

Assume that $\sum x = 66$      $\sum y = 138$      $\sum xy = 1373$

$\sum x^2 = 654$      $\sum y^2 = 2,930$

**You are required to:**

(a) **Draw** a scatter diagram to represent the above data in a graph paper.

(b) **Identify** the type of correlation between $x$ and $y$ using the above scatter diagram.

(c) **Calculate** the correlation coefficient using the above data. (07 marks)

(Total 20 marks)

———— *End of Section C* ————

# ACTION VERB CHECK LIST

| Knowledge Process | Verb List | Verb Definitions |
|---|---|---|
| **Level 01 Comprehension**<br><br>Recall & explain important information | **Define** | Describe exactly the nature, scope, or meaning. |
| | **Draw** | Produce (a picture or diagram). |
| | **Identify** | Recognize, establish or select after consideration. |
| | **List** | Write the connected items one below the other. |
| | **Relate** | To establish logical or causal connections. |
| | **State** | Express something definitely or clearly. |
| | **Calculate/Compute** | Make a mathematical computation |
| | **Discuss** | Examine in detail by argument showing different aspects, for the purpose of arriving at a conclusion. |
| | **Explain** | Make a clear description in detail revealing relevant facts. |
| | **Interpret** | Present in an understandable terms. |
| | **Recognize** | To show validity or otherwise, using knowledge or contextual experience. |
| | **Record** | Enter relevant entries in detail. |
| | **Summarize** | Give a brief statement of the main points (in facts or figures). |

| Knowledge Process | Verb List | Verb Definitions |
|---|---|---|
| **Level 02 Application**<br><br>Use knowledge in a setting other than the one in which it was learned / Solve closed-ended problems | **Apply** | Put to practical use. |
| | **Assess** | Determine the value, nature, ability, or quality. |
| | **Demonstrate** | Prove, especially with examples. |
| | **Graph** | Represent by means of a graph. |
| | **Prepare** | Make ready for a particular purpose. |
| | **Prioritize** | Arrange or do in order of importance. |
| | **Reconcile** | Make consistent with another. |
| | **Solve** | To find a solution through calculations and/or explanation. |

| Knowledge Process | Verb List | Verb Definitions |
|---|---|---|
| **Level 03 Analysis**<br><br>Draw relations among ideas and compare and contrast / Solve open-ended problems. | **Analyze** | Examine in detail in order to determine the solution or outcome. |
| | **Compare** | Examine for the purpose of discovering similarities. |
| | **Contrast** | Examine in order to show unlikeness or differences. |
| | **Differentiate** | Constitute a difference that distinguishes something. |
| | **Outline** | Make a summary of significant features. |

# FORMULAE SHEETS

## Mathematical Fundamentals:

Quadratic equation:

The solutions of a quadratic equation,
$ax^2 + bx + c = 0$ is given by

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Arithmetic sequence:

The sum of first n terms of an AP:
$$S = \frac{n}{2}\{2a + (n-1)d\}$$

Geometric sequence:

The sum of first n terms of a GP:

$$S = a\,\frac{\{r^n - 1\}}{\{r-1\}} \quad \text{if} \quad r > 1$$

$$S = a\,\frac{\{1 - r^n\}}{\{1 - r\}} \quad \text{if} \quad r < 1$$

$$S = na \quad \text{Otherwise} \quad r = 1$$

## Quantitative Finance:

Simple interest:
$$S = X\,(1 + nr)$$

Compound Interest:
$$S = X\,\{1 + r\}^n$$

Discounting:

Present Value = Future Value $\times \dfrac{1}{(1+r)^n}$

Repayment of mortgage:

$$A = \frac{SR^n(R - 1)}{\{R^n - 1\}}$$

Internal Rate of Return:

$$IRR = \frac{[N_1 r_2 - N_2 r_1]}{[N_1 - N_2]}\%$$
Or
$$IRR = a\% + \frac{NPV_A}{[NPV_A - NPV_B]}\,(b - a)\%$$

## Numerical Descriptive Measures:

Mean $\bar{x}$ :

For ungrouped data: $\dfrac{\sum x}{n}$

For grouped data: $\dfrac{\sum fx}{\sum f}$

Standard deviation $\sigma$:

For ungrouped data:

$$\sqrt{\frac{\sum(x - \bar{x})^2}{n}} \quad \text{or} \quad \sqrt{\frac{\sum x^2}{n} - \bar{x}^2}$$

For grouped data:

$$\sqrt{\frac{\sum f(x - \bar{x})^2}{\sum f}} \quad \text{or} \quad \sqrt{\frac{\sum fx^2}{\sum f} - \bar{x}^2}$$

Coefficient of variation (CV):

$$\frac{Standard\ deviation}{Mean} = \frac{\sigma}{\bar{x}}\ \text{x } 100$$

## Comparing Two Quantitative Variables:

Pearson's Product Moment Correlation.

Correlation coefficient (r):

$$\frac{[n\sum xy - \sum x \sum y]}{\sqrt{\{[n\sum x^2 - (\sum x)^2] \times [n\sum y^2 - (\sum y)^2]\}}}$$

Regression coefficients (a and b):

$$b = \frac{[n\sum xy - \sum x \sum y]}{[n\sum x^2 - (\sum x)^2]}$$

$$a = \bar{y} - b\bar{x}$$

**Comparison over time with Economic variables**

<u>Index Numbers:</u>

Price Relative $\quad = \dfrac{p_1}{p_0} \times 100$

Quantity Relative $\quad = \dfrac{q_1}{q_0} \times 100$

Value Relative $\quad = \dfrac{v_1}{v_0} \times 100$

Simple aggregate price index $\quad = \dfrac{\sum p_1}{\sum p_0} \times 100$

Simple aggregate quantity index $= \dfrac{\sum q_1}{\sum q_0} \times 100$

Average price relative $= \dfrac{1}{n} \sum \dfrac{p_1}{p_0} \times 100$

Average quantity relative $= \dfrac{1}{n} \sum \dfrac{q_1}{q_0} \times 100$

Weighted aggregate indices
1) <u>Base-weighted / Laspeyre's:</u>

   Price index $\quad = \dfrac{\sum p_1 q_0}{\sum p_0 q_0} \times 100$

   Quantity index $\quad = \dfrac{\sum q_1 p_0}{\sum q_0 p_0} \times 100$

2) <u>Current-weighted / Paasche's:</u>

   Price index $\quad = \dfrac{\sum p_1 q_1}{\sum p_0 q_1} \times 100$

   Quantity index $\quad = \dfrac{\sum q_1 p_1}{\sum q_0 p_1} \times 100$

3) <u>Using standard weights</u>

   Price index $\quad = \dfrac{\sum p_1 w}{\sum p_0 w} \times 100$

   Quantity index $\quad = \dfrac{\sum q_1 w}{\sum q_0 w} \times 100$

Weighted average of relatives

Price index $\quad = \quad \dfrac{\sum [w \times I_p]}{\sum w} \times 100$

Quantity index $= \quad \dfrac{\sum [w \times I_q]}{\sum w} \times 100$

<u>Time Series:</u>

Additive model
Y = T + S + C + R

Multiplicative Model

Y = T × S × C × R

**Sets and Probability**

$\cup$ - Union;  A∪B defines all elements in A plus all elements in B, no element being counted twice.

$\cap$ - Intersection;  A∩B defines all elements included in both A and B.

P (A) – Probability of event A
P (A/B) – Probability of event A, given B

<u>General rules:</u>
P (A∪B) = P (A) + P (B) – P (A∩B)

$P(A/B) = \dfrac{P(A\cap B)}{P(B)}$

<u>Expectation and Variance of a discrete random variable:</u>

$E(X) = \sum(probability \times pay\,off) = \sum p \times x$

$VAR(X) = \sum px^2 - \left(\sum px\right)^2$

<u>Normal Distribution:</u>

$Z = \dfrac{x - \mu}{\sigma}$